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Contribution of SHP Stations to the development of an area and their social acceptance

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ABSTRACT

The global community, but also the European Union particularly, has launched in recent years a series of actions and measures for the promotion of the renewable energy sources (RES) in the context of dealing with the climate change. Small hydropower (SHP) stations can play a vital role in the increasing energy demand, helping to reduce the mankind dependence to the fossil fuels. In addition, SHP stations have significant advantages as they contribute to the development of the local economy and to the reduction of the environmental pollution.

Changing the legislative framework in recent years in Greece increased the penetration of RES in the country's energy system and encouraged the private initiative in this area.

The study was carried out in an area of Northern Greece (Prefecture of Pella) where the installation of private SHP stations is particularly impressive over the last decade (in relation with other parts of the country). The main conclusions of the study carried out with a questionnaire are that there is an important acceptance of SHP stations from the residents recognizing the role that they play in the regional development and in the protection of the environment making them more attractive to investors.

Contents

1. Introduction

The energy resources are resources of strategic importance for the function of economic system, the financial development and the social welfare of a country. In particular, after the crises of 1973 and 1979 it was found that immediate measures globally must be taken in order to deal with the energy problem. So, in many countries, measures are taken related to the substitution of fossil fuels with renewable energy sources (RES) and also to the development of energy saving technologies [1]. In recent years, geopolitical changes accompanied by increases in fuel prices brought the issue of security of supply of energy products at affordable prices to an important position of the international political agenda [2].

The RES can contribute significantly to the energy production globally, helping to reduce the dependence of the fossil fuels and to reduce the emissions of greenhouse gases and other gaseous pollutants contributing with this way to the environmental protection. The RES are the third largest source of electricity production globally. They represent approximately 18% of the electric energy production, after carbon (40%) and gas (almost 20%) [2].

To the Summit of the EU leaders on 8/9 March 2007, the European Council, taking into account the European Commission's proposal for an "Energy policy for Europe", adopted a comprehen-

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sive energy Action Plan for the period 2007–2009. The centre of the new European energy policy is that the EU should reduce their emissions of greenhouse gases by 20% until 2020 compared to 1990 levels. To achieve the central strategic objective, the commission proposes in parallel, the achievement of three related objectives targeting 2020: improvement of energy efficiency by 20%, increasing in the rate of penetration of renewable energy sources to the energy mix by 20% and increasing the proportion of biofuels in transports by 10%.

In developing countries investments and particularly public investments are of great importance for the development of an area or the entire country. In particular the development projects built in backward areas, as well as labor–Intensive projects which are presumed to increase the income of the poorest classes are an important instrument of the policy for the redistribution of income. Examples of such development projects are the irrigation and water resources management projects, transportation projects, hydroelectric projects and generally energy projects [3–6].

Today, we have great energy production with the use of water. Almost 90% of electricity produced from renewable energy sources comes from hydropower stations [2]. China, Brazil, Canada and the United States are countries with rich hydrodynamics which they use for power generation. In Brazil, the hydroelectric energy reaches 85.56% of the total production of energy [7].

It is true that the large hydropower stations play crucial role in power generation. But there are also cases where there is an urgent need to establish small hydropower (SHP) stations which represent important advantages such as: (a) they do not have waste or residues, (b) they do not pollute the environment, (c) they have very low maintenance cost and (d) the cost of energy produced does not vary widely, and the operating costs is small. Also, their construction is usually combined with irrigation, water supply, flood setting, fishing, leisure activities and ecotourism helping the development of local economy [8–14].

The SHP stations are very good appliances for the generation of electric energy not only for the remote regions but also in cooperation with the central transport network and distribution of electricity [15].

Globally, there are many opportunities for SHP stations installation from hydraulic works made for other purposes, e.g. for irrigation canals, dams for water supply purposes. There was a wave of opposition against hydroelectricity especially in areas where large dams were built. But when hydropower (HP) stations are designed, are built and are operated in accordance with the social needs and are compatible with the environment have an important role to play in the future of energy supply in the world [16].

The determination of the construction and installation of a hydropower station depends largely on social, economic and political factors while the environmental impact of large hydropower stations is important [17].

Turkey is a country of energy dependent on oil and gas [18]. There are not large reserves of oil and gas but there is rich hydrodynamics that can be used to produce electricity. The capital and technology are key and crucial factors for the implementation of energy investments in this area [19]. The RES is the second largest source of energy after the coal. The RES and especially hydroelectricity can contribute to the economic development of Turkey. Generally, the cost of SHP stations and their maintenance is not high. It is expected that over the next decades many foreigners will be interested in investing in the Turkish market of hydroelectricity [11]. Significant impetus for the development of SHP stations is given by a law published in 2005. So in 2007 the hydroelectric dynamics in Turkey was increased by 15% compared with 2006 [20]. Moreover, in Turkey there are all those appropriate hydrological and topographic conditions for the development of SHP stations [21]. The contribution of SHP stations in electricity production is very important [22]. Because of the social and economic development in Turkey, energy and electricity demand is growing rapidly. The hydroelectricity can cover the 25–35% of electricity demand by 2020. With the development of hydroelectric potential of the country, the economic situation of the rural population will be improved, most of whom are unemployed and poor, and thus the unemployment will be reduced while the supply of electricity will be cheaper for domestic use [21].

The great demand for energy and the environmental pollution in China has led to their recovery of their hydropower too. This recovery, however, should be done in a manner compatible both with the environment and with the less possible social consequences. In the mountain regions of India the hydroelectricity is in abundance and is an economic and environmentally clean renewable energy source [23].

In several countries of the Middle East clear objectives have been set to achieve partial self-sufficiency by RES to cover their energy needs. Jordan aims at production of 5% of the electricity from RES until 2010, Saudi Arabia aims at production of 10% of electricity from RES until 2020 and Syria to 4% until 2011 [24].

According to the economic analyses carried out on potential investments in Norway, it was found that the SHP stations are encouraged more [25]. In countries like Nepal the response to install SHP by private investors was not encouraged due to the high requirements of the investment [26]. Greece a techno-economic evaluation of SHP station was carried out and it was found that the prices of the Internal Rate of Return are greater than 18% for most cases analyzed [8].

In Portugal, the socio-economic consequences of the construction of large-HP station were studied and it was found that they can contribute to the creation of new activities related to sport, tourism and recreation, to promotion of the diversification of the local economy and to the increase of employment [27].

In a study carried out in 2005 for the ten candidate countries for accession to the EU regarding SHP stations, it was found that Hydroelectricity is the main RES regarding its participation to the production of electricity [28].

2. Energy policy in Greece

The main axes of energy policy in Greece in recent years are: (a) the security of energy supply in the country, (b) the diversification of energy sources with the aim of reducing energy dependence of the country, (c) the protection of the environment and (d) the improvement in productivity and competitiveness through energy investment of net energy technologies while ensuring regional development.

In particular, the main objectives of energy policy in the country are: (a) the safety of energy supply to the energy market with high quality products at the best possible prices, (b) the reduction of oil dependence of the country and gradual replacement of oil by natural gas, (c) strengthening the system of production, transmission and distribution of electricity, (d) increasing the participation of RES in the energy system of the country, (e) the extension of the use of natural gas with the development of new transmission and distribution nets, (f) the liberalization of the electricity and gas markets, (g) strengthening the international interconnections of the country with its participation to the construction of energy networks and (h) financing the energy infrastructure of the country and strengthening private energy investments [2].

In 2008, the contribution of RES to the energy balance in Greece is around 5.6% in relation to total gross domestic consumption and around 17.7% in the level of domestic production of primary energy. The same year the production of primary energy from RES

was amounted to 1.8 Mtoe, while at the beginning of the nineties to 1.2 Mtoe and in 2000 to 1.44 Mtoe. In this production 357 ktoe (19.7%) are because of the production of hydroelectric stations [29]. The production of electricity from RES in 2008 was amounted to 6.6 Twh and the share of hydroelectric stations was amounted to 63%.

The development of RES is a key priority for Greece both for the reduction of energy dependency and for the protection of the environment according to the European directives and international treaties.

The Community directives 96/92/EC and 2003/54/EC signed the competition in the electricity market and forced the Member States to adapt their legislation accordingly. In Greece the adaptation was made on the basis of law 2773/99, 3175/2003 and 3426/2205 [15].

Both by the Kyoto Protocol and by Directive 2001/77/EC of the European Parliament and of its Council of 27 September 2001 “On the promotion of electricity from renewable energy sources in the internal market of electricity”, for Greece, there are explicit obligations for penetration of electricity production from renewable energy sources (RES).

Nevertheless, up to 2006, the institutional framework for the licensing of works RES was characterized by malaise, long delays because of bureaucratic, inefficiency and complexity, resulting in the development of RES in Greece non-accelerating.

With the new law 3468/2006 regarding the production of electricity from RES and units of Cogeneration of Electricity and Heat of High Efficiency a systematic framework for authorization of plants producing electricity from these units was organized and rendered and settings were introduced to simplify and speed up significantly the authorization procedure, to ensure the implementation aiming at the same time the full compliance both with the Kyoto Protocol and the Community directives [2]. Finally, the last law 3854/2010 regulates various issues to accelerate the development of renewable energy to combat climate change.

As regards the hydroelectricity, it has contributed essentially to the development of the country. The electrification, industrialization and the development of the country were based primarily on the SHP stations of private initiative. Dozens of small large industrial units were established along rivers in regions of Macedonia with the aim of exploiting the power of water. Until the beginning of the 1950s, there were 17 private SHP stations total installed power approximately 10 MW, prior their being sold to the Public Power Corporation (PPC) in Greece. After the adoption of law 2244/94, (which is a milestone for the development of SHP stations) the commitment and participation of several private companies in the construction and operation of SHP stations started again [30].

In Greece the theoretically exploitable potential for SHP stations is estimated at 3400 MW. The theoretical value of hydropower in Greece is 80,000 GWh/year, with estimated production capacity of 30,000 GWh/year. From this amount only almost 16,000 GWh can be considered as economically acceptable hydroelectric potential [15].

In Greece, and in particular in Western and Northern mainland there is important hydropower which until now has not been fully exploited [8,13,31]. In a mountainous country such as Greece, the SHP can create job opportunities for locals contributing to local development [12].

In conclusion, the further development of hydroelectric energy is promising, as the legislative framework has been updated and the morphology of the territory of the country is quite favorable to creating hydropower. Hydroelectric development in Greece is away significantly from a future point of saturation. There are hundreds of places in mountain and island regions of the country where SHP stations can be installed [32].

3. Methodology

3.1. Area of the research

The research was carried out in the Prefecture of Pella in the region of Central Macedonia. This prefecture was chosen because the development of SHP stations is impressive in recent years, as SHP stations that there are or have been licensed there, are of total power of 32.83 MW (i.e. more than 1/3 of the total power in the region of Central Macedonia) [33].

According to the Census of 2001, the population of the County comprises 143,957 people against 136,726 inventory of 1991, there has been an increase of 7231 people [34].

The Prefecture of Pella gathers a rate of 1.3% of the population of Greece and generates 0.8% of GDP (41st in the ranking of 52 prefectures of Greece and 60% of the country) [35]. It has significant comparative advantages as climate and natural resources (fertile plains and agricultural areas, forests, rangelands, productive and rich water resources) contributing to the development of primary sector and in recent years in tourist development, too.

The Prefecture of Pella is one of the most dynamic districts in the primary sector of the country. Agriculture accounts for 20% of GDP in 2005, falling from 26% in 2000. In this prefecture, the 3.5% of agricultural production of the country takes place and it is first in the production of peach, fourth in the production of apples and fifth in production of milk and rice. Processing accounts for 11% of the product of the prefecture in 2005 [35]. The forestry is highly developed and there is significant production of forest products. Important growth is noticed at the sector of the mountain-ski tourism, since the ski centre of Voras is a pole of attraction for thousands of visitors from all over Greece, as well as in the field of spa tourism where the springs in the area of Aridaia attract many tourists too.

The purpose of the work is to investigate the views of citizens of the Prefecture of Pella on the implications of the establishment and operation of SHP stations in the development of the prefecture and the quality of life, showing by this the possibilities of cross-contribution to the local economic and social system and to the environmental stability.

3.2. Sampling method

The sampling method chosen was the Simple Random Sampling, in view of the advantages it shows [36–38]. The investigated ‘population’ is the total number of households in the Prefecture of Pella. The sampling frame used was the directories of home electricity consumers.

The sample size was assessed on the basis of the types of simple random sampling [36,37,39]. Because the variables refer to ratios, the determination of the total size of the sample is given by:

$$n = \frac{t^2 \hat{p}(1-\hat{p})}{e^2} \quad (1)$$

where $\hat{p}$ = the estimated proportion; t = the value of the STUDENT distribution for probability $100(1-a) = 95\%$ and $n-1$ degrees of freedom. When the t-distribution approaches the form of the standard normal distribution [39] and for 95% takes the value 1.96 [37,39]; e = the maximum admissible difference between sampling instrument and the unknown instrument of the population. We accept that it is 0.05, i.e. 5%.

Before calculating the size of the sample we pre-sampling, with sample size of 50 persons. So, for each variable the proportion of the population ($\hat{p}$) was calculated. The size of the sample was assessed for each of the variables of the questionnaire. The variable “the current development of the area can be supported in agri-

culture" presented the higher proportion value, $\hat{p} = 0.5$, therefore $1 - \hat{p} = 0.5$, so the sample size is:

$$n = \frac{t^2 \hat{p}(1-\hat{p})}{e^2} = \frac{1.96^2 \cdot 0.5.(1-0.5)}{0.05^2} = 384.16$$

So the sample size was 385 people.

With the help of the tables of random numbers, sample households were identified (name and address). Then personal interviews to a member of the family were conducted, who was chosen randomly [40,41]. Data collection was done in 2010 and for statistical analysis the statistical package SPSS was used.

3.3. The questionnaire research-statistical analysis

This research was done by means of a structured questionnaire and used the method of the personal interview. The interview is one of the best ways to collect statistical information and is used on sample surveys [42,43]. For structuring the questionnaire the relevant literature taken into consideration had to do with the effects of RES in the local economy and society [8,13,31,44–49].

The primary data collected and presented in this investigation relate to socio-demographic characteristics of respondents and their views and attitudes for the development of their area, but also for the role of SHP stations in quality of life and, more generally, in the development of the area.

The primary data that were gathered and presented in this research were: (1) social-demographic profile of the sample and (2) contribution of SHP stations to the quality of life (a multidisciplinary question Q_4, 9 items). This question (Q_4) was closed type and it was measured in the 5° scale with 5 corresponding to the highest attitude (I absolutely agree) and 1 corresponding to the lowest attitude (I absolutely disagree). These items are: (a) increase the income of the local population (employed in SHP stations) (Q_{4_1}), (b) ensure the availability of electricity in perpetuity (Q_{4_2}), (c) improve residents' stay through fees that give the SHP stations owners (Q_{4_3}), (d) through the corporate social responsibility (CSR) and sponsorship supported bodies and authorities in the area (Q_{4_4}), (e) reduce the aesthetics of the landscape and the environment in general (Q_{4_5}), (f) reduce the fish fauna (Q_{4_6}), (g) the noise from the operation of the plant disturbs the fauna of the area (Q_{4_7}), (h) infrastructure networks are upgraded (Q_{4_8}) and (i) they contribute to the ecotourism development (Q_{4_9}). (3) The priorities that should be provided for each of the potential benefits of the SHP stations (multidisciplinary question Q_{11}, closed type and measuring scale from 1 to 3, 1: low priority 2: moderate priority 3: high priority, 6 items). These items are: (a) recreation for the local people (Q_{11_1}), (b) creation of employment opportunities (Q_{11_2}), (c) protection of nature and the natural environment (Q_{11_3}), (d) creation of an attractive and beautiful landscape (Q_{11_4}), (e) generation of electric energy (Q_{11_5}) and (f) financial support of the local community (fees, sponsorship, etc.) (Q_{11_6}).

The statistical analysis of the date was done with the statistical package SPSS 15.0 and included Descriptive Statistics, principal component analysis (PCA) and cluster analysis.

4. Results and discussion

Regarding the socio-demographic characteristics, 56.6% of respondents in the sample are men and 43.4% are women. The largest percentage is between 31 years and 48 years (57.4%), the smaller percentage of the youngest ages (31.7%) and far lower is for ages over 48 years (10.9%). The relative majority (39.5%) has finished High school, while very important (31.9%) is the percentage of those who have completed Higher education (Universities/Technological Educational Institutes). Most respondents (compared with other professional categories) are farmers (22.9%). 43.9% stated income up to 10,000 euros, while 35.1% stated income between 10,001 and 15,000 euros.

With respect to the sectors where the development of the area depends, almost half (49.6%) of respondents believe that a major boost is given by the agriculture and about 1/3 (27.8%) believes that agriculture contributes a little.

Over one-third of respondents (35.3%) believes that tourism gave great development impetus in the area, and even higher (46.8%) is the percentage of those who believe that tourism impacted little to the development path.

Almost 1/3 (27.5%) believes that the RES contribute significantly to the development of the area while the percentage of those who have the opposite view is greater (41%). Almost the same views have those questioned for livestock industry (27.3% and 43.4%, respectively).

As regards the sectors that the future development of the area must be supported, the vast majority (83.6%) believes that tourism can give great development momentum, while it is very small the percentage (9.9%) of those who believe that tourism can give great development, as the use of whirlpool baths of Aridaia and the establishment of the ski centre Voras give significant prospects for development of the area. Also most respondents (67.5%) believe that a traditional sector such as agriculture can contribute to the future development of the area, while 25.7% believes that it cannot be supported in agriculture. Agriculture, although, presents a continuous decline in terms of its contribution to the GDP of the County, however, it is for many a branch with a long tradition and future who takes advantage of the rich and fertile soils of the Prefecture.

The RES is a sector that can support the future development of the area for approximately two-thirds (66%) of respondents, while very small is the percentage of those who believe (15.1%) that they can contribute a little to the future development. In recent years both the installation of SHP stations and of photovoltaic systems has given promising prospects for the development of the prefecture. 32.5% of the respondents neither agrees/nor disagrees that the quality of life is good, while 33% disagrees that there is a great reconstruction. The vast majority disagrees (85.5%) that there is a great crime rate in their area. They generally agree that there are no opportunities for employment (69.3%) of residents in the area.

Around half (43.1%) agree that there is no active participation of residents in the development of the area. Also, about half feel that the services are not good (45.7%), several neither agree/nor disagree (28.6%) and others consider that the services are good (35.7%). Approximately half (39.5%) disagree that there are opportunities for sport. Very important (47.9%) is the percentage of those who agree that there are opportunities for recreation.

More than half agree that there is a large number of visitors/tourists in the area (55.4%), while most disagree that there is a great industrial development (59.1%).

In conclusion, in the rural economy, in recent decades changes derived from the tendency of globalization of the world economy, the liberalization of international trade, the successive reforms of the Common Agricultural Policy (CAP) and the strengthening of the role of the structural policies of the European Union are noted. Despite its regressive role, the Greek Agriculture occupies an important position in the Greek economy and particularly in the rural economy, where agricultural activity dominates due to the concentration of other economic activities – processing, services – in large urban centers of Athens and Thessaloniki [41]. At the same time, however, other activities pop too, with dominant the tourism, while in recent years RES is an important factor in the development process of an area which cannot be disregarded by the policy planners.

The Prefecture of Pella until the last decade was basically a rural county with significant agricultural production and static indus-

trial activity. The last decade, the tourist exploitation of natural resources (mountainous tourism, ski tourism, spa tourism) and the development of RES (SHP stations, photovoltaic systems) intensified significantly the local economy contributing to its complete development. Very important role in the development of the county played the community initiatives LEADER, as through these many units related to tourism (hotels, restaurants, leisure) were established.

The views and attitudes of respondents for the contribution of SHP stations to the quality of life are: Nearly half of respondents (42.8%) agree/absolutely agree that the construction and operation of SHP stations increases the income of the local population, but equally important is the percentage of those who disagree/absolutely disagree (34.1%). 23.1% of the respondents neither agrees/nor disagrees with the above view.

The proportion of respondents (63.1%) who agree/absolutely agree with the view that the construction and operation of SHP stations ensures the availability of electricity in perpetuity is very important, while it is a relatively small percentage (23.9%) of those who disagree/absolutely disagree.

Almost equally the views of respondents are shared for whether SHP stations improve residents' stay through fees. 30.7% disagrees/absolutely disagrees, 33.5% agrees/absolutely agrees and 35% neither agrees/nor disagrees. 38.4% agrees/absolutely agrees that through corporate social responsibility and sponsorship supported bodies and authorities of the area. Half (49.9%) consider that the construction and operation of SHP station reduce aesthetics of the landscape, while 25.7% of the respondents neither agrees/nor disagrees with the above view and 24.4% disagrees/absolutely disagrees. More than half of respondents (53.7%) agree/absolutely agree that they reduce fish fauna from the construction and operation of the station and only 26.8% disagrees/absolutely disagrees. 40% agrees/absolutely agrees that SHP stations disrupt the fauna of the area, but equally important is the percentage of those who disagree/absolutely disagree with the above view (34.8%).

The percentage (53.5%) of those who agree/absolutely agree with the view that the construction and operation of infrastructure networks SHP stations upgraded the range (roads, telecommunications, electricity transmission networks) is very important, while it is small for those who disagree/absolutely disagree with this point of view (22%).

More than 1/3 (36.9%) disagree/absolutely disagree with the view that the development of SHP station attract ecotourism and equally important is the percentage of those who disagree/absolutely disagree with this viewpoint (29.1%), but also those who neither agree/nor disagree (34%) (Table 1).

On the priorities to be given in each of the potential benefits from SHP stations the views and attitudes of respondents are the following: Almost half (48.6%) consider that it should be given high priority to the recreation for the local people. Very high is the percentage (77.7%) of those who believe that high priority should be given to the creation of employment opportunities that SHP station give, while the percentage of those who have the view that no priority should be given is at 17.7%. Also the percentage of those who believe that high priority should be given to the protection of nature and the natural environment is the same (77.7%).

Table 2
Respondents' views and attitudes for the priority that must be given in future to each of the potential benefits of SHP stations (%).

	High priority	Moderate priority	Low priority	Total
$Q_{11.1}$	48.6	29.4	22.1	100
$Q_{11.2}$	77.7	4.7	17.7	100
$Q_{11.3}$	77.7	11.4	10.9	100
$Q_{11.4}$	62.9	26.2	10.9	100
$Q_{11.5}$	68.1	23.1	8.8	100
$Q_{11.6}$	63.4	19.5	17.1	100

Very high is the percentage of those who believe that high priority should be given to creating a beautiful and attractive landscape (62.9%). Also high is the percentage (68.9%) of those who believe that high priority should be given to the production of electricity, while the percentage of those who believe that low priority should be given is very low. Finally, the percentage (63.4%) of those who believe that high priority should be given to local society through contributory fees and sponsorship is high (Table 2).

Above shows that in general the majority of respondents believe that the SHP stations can contribute in many ways to the development of their area and they are generally positive signifying, of course, that SHP stations also have environmental consequences.

To investigate the structure of the views of the respondents in connection with the contribution of SHP stations to the quality of their life, the principal component analysis (PCA) was applied with varimax rotation of factorial axes to residents' replies (multidisciplinary question Q4).

The analysis revealed two important factors or factorial axes with a total of 72.6% of total variance.

The first factorial axis (F_1) with eigenvalue 4.8 interprets 52.9% of the total variance, and the second with eigenvalue 1.8 interprets 19.7%. This axis is built mainly of items $Q_{4.2}$, $Q_{4.3}$, $Q_{4.4}$, $Q_{4.1}$, $Q_{4.9}$ $Q_{4.8}$, and can be identified as an economic-development dimension of the contribution of SHP station in quality of life.

The reliability of the factorial axis with the concept of internal consistency was evaluated on the basis of the value of the indicator Cronbach's a. Based on the available data, this indicator, for the first factorial axis, was measured 0.91 indicating very satisfactory reliability. The average factorial degree was estimated 3.2 ($\pm$1.0) and is neutral attitude for economic-development dimension of the contribution of SHP stations to the quality of life.

The second factorial axis (F_2) is built mainly of items $Q_{4.5}$, $Q_{4.6}$, $Q_{4.7}$, and can be identified as aesthetic-environmental dimension of the contribution of SHP station to the quality of life. Its credibility was found to be $a = 0.86$, value which is considered very satisfying too. The average factorial degree was estimated 3.3 ($\pm$1.1) value that represents a neutral attitude for aesthetic-environmental dimension of the contribution of SHP stations to

Table 1
Respondents' views and attitudes for SHP stations contribution to the quality of life (%).

	I absolutely agree	I agree	Neither agree/nor disagree	I disagree	I absolutely disagree	Total
$Q_{4.1}$	23.6	19.2	23.1	16.4	17.7	100
$Q_{4.2}$	23.9	39.2	13.0	14.5	9.4	100
$Q_{4.3}$	10.9	22.6	35.8	15.1	15.6	100
$Q_{4.4}$	8.8	29.6	39.2	9.6	12.7	100
$Q_{4.5}$	20.0	29.9	25.7	16.1	8.3	100
$Q_{4.6}$	22.3	31.4	19.5	20.3	6.5	100
$Q_{4.7}$	15.1	24.9	25.2	25.2	9.6	100
$Q_{4.8}$	20.3	33.2	24.2	18.7	3.6	100
$Q_{4.9}$	10.9	18.2	34.0	24.4	12.5	100

Table 3
Rotated component matrix.

	Component	
	1	2
$Q_{4.2}$	0.850	
$Q_{4.3}$	0.839	
$Q_{4.4}$	0.834	
$Q_{4.1}$	0.825	
$Q_{4.9}$	0.791	
$Q_{4.8}$	0.681	
$Q_{4.5}$		0.901
$Q_{4.6}$		0.854
$Q_{4.7}$		0.832

Extraction method: principal component analysis; rotation method: varimax with Kaizer normalization.

the quality of life. The overall credibility of the multidisciplinary question Q_4 was considered $a = 0.88$, a very satisfying value.

Regarding the suitability of the data to apply PCA we have to observe the following: (a) the Kaiser–Mayer–Olkin indicator (KMO) was estimated at 0.82 > 0.60 (a value of 0.60 is considered to be an acceptable limit of data) and (b) the test of sphericity of Bartlett has given the following results ($X^2 = 2190.9$, df = 36, $p < 0.001$) which means that the corresponding correlation matrix differs statistically significantly from the Unitary matrix. Also the communalities for each item were greater than 0.60 which shows very good quality reconstitution of the primary data in the form of two factorial axes.

Finally, the first factorial axis, the discrimination indices (which indicate the internal consistency this is a part of the validity) of their respective items were above 0.65 while for the second factorial axis they were over 0.70 (values >0.20 are considered satisfactory). The two factorial axes as identified conceptually have moderate negative and statistically significant correlation ($r = -0.398$, $p < 0.001$) which means that a significant proportion of respondents for the positive contribution of SHP stations economic-development of the area are not consistent with their views on the contribution of SHP stations in aesthetic-environmental improvement of their area.

They agree that SHP stations have positive economic and developmental impact but they believe that SHP stations installation and operation has environmental impact too. Therefore, there must be better information on all the effects (developmental, economic, social and environmental) of SHP stations, so that the residents have a better and fuller view for their role (Table 3).

To investigate the structure of the views and attitudes of respondents in relation to the priorities that should be provided for each of the potential benefits of the SHP stations, varimax rotation of factorial axes was applied to the residents' replies (items Q_{11_1}–Q_{11_6}).

The analysis revealed two important factorial axes which represent totally 75.5%. The first factorial axis (C_1) with value 3.4 represents the 57% of the total variance, and the second (C_2) with value 1.1 represents the 18.5%.

The first factorial axis is characterized primarily by the items Q_{11_4}, Q_{11_2}, Q_{11_3}, Q_{11_1} and can be identified as the priority to the environment. The reliability of the first factorial axis with the concept of internal consistency was evaluated on the basis of the value of the indicator Cronbach's a.

Based on the available data, this indicator for the first axis, measured in $a = 0.86$ indicating very satisfactory reliability. The average factorial degree was estimated 3.6 (±0.6) value representing a trend towards agreement on the priority to be given to the environment.

The second factorial axis is mainly built from the items Q_{11_5}, Q_{11_6}, and can be identified as a priority for economic-development progress of the area from the construction and operation of SHP station and its reliability was found to be $a = 0.73$, value which is considered to be satisfactory. The average factorial degree for this axis has been estimated at 3.7 (±0.6) and is also a trend towards agreement on economic-development progress of the area.

Table 4
Rotated component matrix.

	Component	
	1	2
$Q_{11.4}$	0.861	
$Q_{11.3}$	0.802	
$Q_{11.2}$	0.780	
$Q_{11.1}$	0.779	
$Q_{11.5}$		0.933
$Q_{11.6}$		0.764

Extraction method: principal component analysis; rotation method: varimax with Kaizer normalization.

The overall reliability of the multidisciplinary question Q_{11} is $a = 0.84$, a very satisfying value.

Regarding the suitability of the data to apply the PCA we observe the following: (a) the KMO was calculated 0.73 > 0.60, (b) test of sphericity of Bartlett has given the following results ($X^2 = 1248.99$, df = 15, $p < 0.001$) which means that the corresponding correlation matrix differs statistically significantly from the Unitary matrix. Also the communalities for each item were greater than 0.60, which shows very good quality of reconstitution of the primary data in the form of two factorial axes.

Finally, for the first factorial axis, the discrimination indices of the respective items were over 0.54, while for the second factorial axis they were over 0.58 (Table 4).

The two factorial axes' intercorrelations show strong, positive and statistically significant correlation ($r = 0.474$, $p < 0.001$) which means that a significant proportion of respondents reported their views on the two priorities are in agreement. They give high priority to both factorial axes.

Also there were associations between the two factorial axes. It was found that there is a moderate positive and statistically significant correlation ($r = 0.439$, $p < 0.001$) between the factorial axes F_1 and factorial axis C_1. The respondents agreeing for economic and development impact of SHP stations (F_1) agree on the priorities that should be given to the protection of the environment (C_1) too.

Moderate positive and statistically significant correlation ($r = 0.401$, $p < 0.001$) was found between F_1 and C_2. This means that there is an agreement between the views of respondents in both axes. The views of respondents who agree on the positive contribution of SHP stations to the development of the area, as expected, are in line with their views on the priorities that should be given (in this case economic-development dimension).

There is a weak negative and statistically significant correlation ($r = -0.160$, $p = 0.002$) between the factorial axis F_2 and factorial axis C_1. This means that a relatively small proportion of respondents for the environmental impacts of SHP stations do not comply with the priorities given (economic-development).

Also, there is a moderate negative and statistically significant correlation ($r = -0.299$, $p < 0.001$) between the factorial axis F_2 and factorial axis C_2. This means that a significant proportion of respondents for the negative effects of SHP stations to the environment do not comply with the priorities given (economic-development).

Then we did a cluster analysis for the factorial axes F_1 and F_2. In the context of this work the cluster analysis of K means was applied and in particular the method of Ward. Because the variables are different scales-units of measurement, we converted the original units (z-score, mean = 0, Std. deviation = 1). 3 clusters were formed (Table 5).

The first cluster includes 142 individuals (36.9%), with an average age of 37.5 years, the second 143 (37.1%) with an average age of 33.7 years and the third 100 (26.0%) with an average age of 36.5 years (Table 6).

Table 5
Typology of respondents regarding factorial axes F_1 and F_2.

Clusters		F_1	F_2
1	Mean	2.4	4.3
	Median	2.3	4.3
	Std. deviation	0.7	0.6
	N	142	142
2	Mean	3.9	3.3
	Median	3.8	3.3
	Std. deviation	0.5	0.4
	N	143	143
3	Mean	3.4	1.9
	Median	3.4	2.0
	Std. deviation	1.0	0.5
	N	100	100
Total	Mean	3.2	3.3
	Median	3.3	3.3
	Std. deviation	1.0	1.1
	N	385	385

Table 6
Age and number of individuals of each cluster.

Clusters	Mean	Median	Std. deviation	*N*
1	37.5	42.0	11.4	142
2	33.7	31.0	13.6	143
3	36.5	37.0	6.9	100
Total	35.8	37.0	11.5	385

The three clusters have a statistically significant difference between them and between the two factorial axes. Those who generally disagree (2.4) in economic-development impacts of SHP stations belong to the first cluster (they consider that they do not contribute to the development of the area), while there is agreement on the environmental impact they cause (noise, reduction of fish fauna, etc.).

Those who believe (3.9) that SHP stations contribute to the development of the area and are neutral with regard to the environmental impact (3.3) belong to the second cluster. They are doubtful, that is, regarding the environment. Those who are generally neutral (3.4) with regard to the incentive role of SHP stations but on their views there are not any environmental consequences (1.9) belong to the third cluster.

For further exploration of the profiles of the three types of respondents, we moved to the development of a second-level profile regarding the priorities that should be given (Table 7).

Table 7
Typology of respondents regarding the factorial axes C_1 and C_2.

Clusters		C_1	C_2
1	Mean	3.3	3.3
	Median	3.5	3.5
	Std. deviation	0.8	0.8
	N	142	142
2	Mean	3.7	3.7
	Median	3.8	4.0
	Std. deviation	0.3	0.5
	N	143	143
3	Mean	3.5	3.7
	Median	3.8	4.0
	Std. deviation	0.6	0.4
	N	100	100
Total	Mean	3.5	3.5
	Median	3.8	4.0
	Std. deviation	0.6	0.6
	N	385	385

In relation to the factorial axis C_1, the clusters are distinct among them (i.e. there is a statistically significant difference between them).

In relation to the factorial axis C_2, the second and third clusters are not differentiated between them, but they vary from the first. Greater priority regarding the environment is given by the second cluster, after the third, and finally the first. The individuals of the first cluster give a moderate priority to the first factorial axis that is to the environmental protection issues. Also, they give moderate priority to the second factorial axis, to economic-development benefits from the construction and operation of SHP stations. The people of the second and third clusters are more positive to both factorial axes, they give high priority to economic-development benefits from the construction and operation of SHP stations and priority should be given to issues of environmental protection. The second cluster is dominated by women.

To explore a more extensive profile of 3 groups of respondents, we checked their correlation with the socio-economic characteristics. Statistical test X^2 showed that there was a statistically significant relationship between three groups of respondents with sex ($X^2 = 16.451$, df = 2, $p < 0.001$, Cramer's $V = 0.207$).

Based on the value of Cramer's V, the intensity of the relationship is moderate. The differentiation between groups–clusters, the second group is dominated by women.

Also the statistical test X^2 showed that there was a statistically significant relationship between three groups of respondents with the educational level ($X^2 = 97.106$, df = 6, $p < 0.001$, Cramer's $V = 0.355$). Based on the Cramer's value V, the intensity of this relation is classified as moderate. The first group includes people with the lowest educational level, the second group those of high school graduates, while the third group has the highest percentage of people who have studied in Universities or in Technological Educational Institutes.

Statistical test X^2 showed that there was a statistically significant relationship between three groups of respondents with the income ($X^2 = 36.952$, df = 6, $p < 0.001$, Cramer's $V = 0.219$). Based on the Cramer's value V the intensity of this relationship is classified as moderate. The first group includes people between 10,000 and 20,000 euros, but there is also a significant percentage of people with their income to be up to 10,000 euros. The second cluster has people who have the lowest incomes, while the third has the highest rate with higher incomes (12%).

Finally, statistical test X^2 showed that there was a statistically significant relationship between three groups of respondents with the profession ($X^2 = 57.985$, df = 6, $p < 0.001$, Cramer's $V = 0.274$). The intensity of this relationship is classified as moderate.

In conclusion, the first group includes people who are mostly employees (public and private) and freelancers. The second group has a high proportion of unemployed, students and people engaged in the household and the third group includes generally people of all occupational categories and has the highest percentage of farmers. Also, we note that there is a moderate correlation of respondents with their socio-economic characteristics.

5. Conclusions

With the introduction of humanity in the 21st century, the global economic activity has led to energy consumption at record levels. In view of the increasing global concern about the limited quantities of these fuels such as their uncertain invoicing because of the instability of the respective markets and their significant environmental impacts, mankind has begun to seek sustainable energy policies that include the RES.

In general, projects, and in particular the RES projects undertaken by the private sector involve different categories of costs

and benefits to society which do not correspond to real costs and benefits of the sector. The most important ones are the social and environmental impacts.

In particular, SHP stations are an important tool for local and regional development, as they contribute to increasing employment and incomes of the population of the area where they are installed and have very low environmental impact.

Water and all public goods to be protected and distributed for the benefit of the local society, inevitably becomes a subject of social conflict and political debate between different groups. The installation and operation of a SHP station require acceptance by the local community. This is necessary even before the establishment of consultation with the local community to persuade (those who are not convinced) for the multiple benefits of SHP stations. So, setting all of the different perceptions and attitudes of the various social groups (several times with conflicting interests) will contribute to the smooth functioning of SHP stations with mutual benefits for everyone.

Disputes and conflicts can be resolved effectively when all stakeholders agree on rules regarding the distribution of benefits. The environmental policy is called upon to play a leading role in alleviating these contradictions arising from the multiple needs of social groups.

In Greece, the gradual decline of agricultural production and the development new sectors of economy led to the diversification of local economy (tourism, RES).

But, the growing investment interest for RES in certain areas caused strong reactions among local communities (particularly for wind farms).

In this study, we attempted to investigate above all embracing SHP stations in an area with rich aquatic resources and a significant number of SHP stations. The results of the survey indicate that in general the RES is a bright industry for the future development of the area, and that in general there is an acceptance of the respondents to the SHP. The respondents seem to recognize the role played by SHP stations in the development of the area, but they are somehow reticent in terms of environmental impacts. The respondents, i.e. have a fairly comprehensive view on the development role of SHP stations but are concerned about their environmental impact. The visit of the premises where SHP stations are established and informing them about the multiple role of SHP stations will improve their respect towards the environmental impacts.

In conclusion, the search and assessment of subjective elements are necessary not only for the sake of democratic treatment of citizens but also for reasons of ensuring the success of the planned projects and investment, which should be pursued by appropriate and relevant actors. In particular, the views and attitudes of the inhabitants of an area must be taken seriously into consideration by the decision-makers for a more rational energy and development planning.

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